ADOPTION OF MICROWAVE OVENS AMONG A SAMPLE OF OLDER ADULTS IN BLACKSBURG, VIRGINIA

by

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ABSTRACT

The purpose of this study was to identify the extent of adoption of microwave ovens by older adults in Blacksburg, Virginia. Level of adoption was defined and determined as a function of 1) frequency of use of the microwave oven in comparison to the range, and 2) complexity of food preparation. Mere ownership was not considered as an indicator of adoption. Focusing on the final stage of Rogers theory of adoption (1962), three levels of adoption were determined: High, medium, and low.

A random sample of 75 adults 65 years and older was selected from the listing of retired personnel in the 1997-98 Virginia Polytechnic Institute and State University faculty and staff directory. Telephone interviews were conducted to collect information regarding current microwave oven usage patterns and decisions for future use and purchase. Relationships between level of adoption, and user characteristics and microwave oven characteristics were statistically tested.

Results from the study indicate that 56% of these older adults who own a microwave oven are high adopters; i.e. they used the microwave more than the range and performed high complexity tasks. About 52% reported using the microwave oven more frequently than the range. Nearly all respondents were satisfied with the microwave oven in terms of speed and convenience, while 60% were satisfied with quality of foods cooked in the microwave oven. There was no significant difference in level of adoption with age, gender, health condition, and knowledge of microwave oven use. However, level of adoption was significantly higher among older adults who were “never” married or “previously” married compared to those that were “currently” married. Also, level of adoption was significantly lower among those older adults who

had touch controls on their microwave oven compared to those with rotary dials. Other significant results of this study dealt with future use and purchase decisions. About 93% of the respondents indicated a desire to continue using a microwave oven in the future and about 76% indicated that they would purchase one in the future if their current microwave oven “dies.”

Results from this study have implications for appliance manufacturers who can increase sales by targeting this group, researchers in household equipment who can study adoption of other innovative appliances, and developers of retirement communities who might consider providing a microwave oven for use by residents or provide a space where one can be placed.

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CHAPTER I
INTRODUCTION

Background of the Study

Demographic changes are generating considerable interest in product design for the aging user (Haigh, 1993). The elderly population is expected to reach its peak in 2030, with one of every five Americans being over 65 years of age, with a life expectancy of an additional 15 years (American Association of Retired Persons, 1988). These older consumers are on the lookout for products that will help maintain their independence. Older adults prefer to live independently in their own homes as long as possible (AARP, 1988; Brody, 1987). To sustain independence, meal preparation is considered an important instrumental activity of daily living (Singer, 1987). It is highly probable that elderly adults have to use kitchen appliances in order to meet this purpose. Therefore, it is to their advantage to use cooking systems that are easy to use, comprehensible, quick, and safe. The microwave oven is an appliance that offers these advantages.

The microwave oven is one appliance that has found a permanent place in the homes of a majority of consumers today (Whirlpool, 1998). What was once a luxury is fast being considered a necessity due to its several advantages. Freeman (1982) suggested that speed of cooking, convenience in use, and cooler cooking were the most important characteristics that attracted consumers to microwave ovens. Today, the saturation level of microwave ovens is 88.7 percent and models are available in a wide price range from under $100 to about $600 (Clark, 1997). The saturation level is defined as the percentage of American households that currently own a microwave oven.

The advantages and convenience of microwave cooking suggest that it would be a suitable appliance to meet the needs of daily meal preparation for older adults. However, early research on microwave oven use showed that the incidence and frequency of use of microwave ovens was higher in younger age groups than among older adults. Wilson (1969) reported that with the increase of age, incidence of use of

microwave ovens decreased. Convenience and cooking speed of microwave ovens appealed more to younger consumers than older consumers (Freeman, 1982). The reason for this was attributed to the inability of older adults to accept technology and innovative products. Also, the features and design of microwave ovens appear to have been too complex and overwhelming for older adults.

Recent research shows that changing trends are emerging. Microwave ovens have found their way into the homes of older adults. One should note that those younger consumers who had a microwave oven in the 1970s and 1980s may well be in the segment of older consumers now. Meeks and Sweaney (1993) found that older adults were more likely to use microwave ovens to prepare foods from the basic steps in preparation than younger users who used the microwave more for reheating and cooking microwaveable food products. Also, the myth that older adults find the instructions and method of use of microwave ovens difficult to comprehend is fading. In a study conducted by Niemeyer, Rai, and Kean (1997) on older females' opinions about functionality of home products and equipment, the use of the microwave oven was reported among the five easiest product-related tasks.

These results seem to dismiss earlier thinking that older adults have apprehensions about using innovative and technological products and therefore are not comfortable with microwave oven use. It is also possible that the elderly have overcome their apprehensions about the microwave oven and have adopted it as a part of their lifestyle. However, there is no empirical research in this area to document and affirm the changing consumer behavior patterns with regard to microwave usage by older adults. Most of the studies address the usage patterns of the entire population and not specifically older adults. Also, there is no research indicating the role of the microwave oven in the cooking patterns of elderly households and their lifestyle in general.

Statement of the Problem

Aging in place is the most sought after housing option among older adults today. It seems highly probable that older adults would be able to perform the activity of meal preparation more conveniently and probably stay independent for a longer period of

time by using the microwave oven. Even if older adults had to leave their homes due to difficulty in other activities or instrumental activities of daily living, they could still make use of the microwave oven, in whichever facility they were to reside in, for basic meal preparation. Retirement communities and assisted living facilities could provide microwave ovens in their kitchens or at least provide a space for storing one, if they had information on microwave oven usage patterns of older adults and its importance in their cooking lifestyle. However, there are no market survey results or empirical data to document this. Thus, there is a need to know whether older consumers have accepted the microwave oven and adopted it in their day-to-day life.

Purpose of the Study

The primary purpose of this study was to identify the extent of adoption of microwave ovens by older adults. The study addressed the role of the microwave oven in the lifestyle of older adults, whether it had become an integral part of their cooking patterns, and the desire of older adults to make decisions of purchase in the future, and the inclination to use microwave ovens in future residences.

Specific Objectives

The specific objectives of this study were to focus on the microwave oven usage patterns of older adults in terms of:

1. frequency of use in comparison to the range,
2. complexity of food preparation,
3. level of adoption,
4. satisfaction with cooking speed, convenience, and quality of food, and
5. decisions regarding future purchase and use.

Justification of the Study

The consumer market comprises a large proportion of elderly adults today. Harris (1988) reported that older Americans want, need, and are willing to pay for products that give them convenience and independence. The microwave oven, with its advantages of cooking speed, convenience in use, availability range, affordable cost, and versatile performance would be an ideal appliance for the older consumer. Appliance surveys point to high saturation level of microwave ovens but that is only an

indication of sales figures. However, one should understand that ownership of the microwave oven does not necessarily imply use. This study was concerned with the extent of adoption of the microwave oven among older adults who own one. Though previous research has alluded to the fact that microwave ovens are not as popular with the elderly as with younger users for a variety of reasons, Niemeyer et al. (1997) suggested that older females found the use of the microwave oven to be one of the five easiest functional tasks in the home.

Prior to conducting the main study, the researcher conducted a pilot study with older adults to assess the ownership of select appliances, frequency of use, and problems associated with their design. Five retired female faculty of Virginia Polytechnic Institute & State University, over the age of 65, residing in Blacksburg, Virginia, were interviewed in December, 1997, for this purpose. Contrary to previous readings in the field, the researcher found that four of the five women used microwave ovens intensively and did not perceive any design problems with the ones they owned. However, one participant did not possess a microwave oven out of personal choice and felt that it was an unsafe appliance to use. Due to the contradiction in the findings of this pilot study and previous research, the researcher considered this to be an area worth investigating.

Carpenter (1988) studied college students and their adoption of microwave ovens as a tool for meal preparation. Results from her study show that the adoption of the microwave oven was basically a lifestyle choice. The microwave oven attracted college students due to its advantages of speed and convenience that are features sought by many young adults today. This piece of research addresses similar questions regarding extent of adoption of microwave ovens but targets older consumers. Though the “time-saving” characteristic of microwave ovens may not be the primary appeal for older adults, convenience, ease of use, and low-maintenance could be probable influences.

Assumptions

Certain assumptions were made before developing the purpose and design of this study. They are:

1. Most meal preparation tasks require the use of one or more kitchen appliances.
2. The participants of this study use the microwave oven at one of the three levels of adoption.
3. Consumers have adopted the microwave oven according to Rogers' theory of adoption (Carpenter, 1988).
4. Frequency of use and complexity of food preparation are dependent on user characteristics and equipment characteristics.

Delimitations

Certain boundaries were established before conducting the study. These were not to limit the study in any way but were mainly due to time and financial constraints.

1. A random sample was selected from the directory of retired personnel of Virginia Polytechnic Institute and State University. This directory included names and addresses of retired faculty and retired staff, lending some variance to the educational background.
2. Only 75 adults over the age of 65 years and residing in Blacksburg, Virginia, were interviewed for the study.
3. Only the primary or co-primary user of the microwave oven was interviewed and asked to respond based on personal use.
4. In order to be able to get information from a large sample, telephone interviews were conducted instead of personal interviews.
5. Level of adoption was determined only for the microwave oven.

Significance of the Study

This study has significant implications in the fields of gerontology, consumer studies, household equipment research, and housing. Consumer patterns of older consumers in acceptance of technological innovations, such as the microwave oven, are identified. This is probably the last cohort of older adults who might still consider microwave ovens as innovative. The next generation of older adults will probably have adopted the microwave oven as an essential appliance for meal preparation. Also, this study is useful to appliance manufacturers in redesigning some aspects of microwave ovens to target the elderly user and expand the microwave market. Retirement

communities that cater to housing needs of older adults would benefit in terms of knowing whether appropriate storage space for a microwave oven should be incorporated in their kitchens.

CHAPTER II
REVIEW OF LITERATURE

The microwave oven has added an innovative dimension to today's kitchen as a preparation and cooking appliance, differing from traditional cooking appliances. The first domestic microwave oven was introduced in the 1960s by Litton, followed by Amana which brought out the first countertop model in 1968 (Thompson & Sweaney, 1993). Today, the microwave oven is used in 90% of American households and 68% of workplaces (The microwave tidal wave, 1989).

When considering independent living over other housing alternatives, safety, functionality, and convenience of appliances could be a deciding factor for older adults (Olson, 1988). In spite of design innovations targeting the needs of the older adult, Pysarchik (1989) found that dissatisfaction with household appliances still exists among elderly users. Whether the dissatisfaction is due to improper design technicalities or due to resistance of older adults towards new and innovative appliances is yet to be seen.

Theoretical Background

The focus of this study was to identify the extent of adoption of the microwave oven among older adults and was based on Rogers' theory of adoption. Rogers and Shoemaker (1971) suggested that purchase of an innovative product indicated adoption. Certain characteristics were listed as attributes affecting rate of adoption, such as: relative advantage of the innovation over the product it replaces, perceived risk with adopting the innovation, complexity of innovation in terms of extent to which it is difficult to comprehend, compatibility of innovation with existing values and lifestyle, trialability, and observability of results. Other attributes could include financial cost, lifecycle of innovation, and possibility of replacement.

Rogers (1962) proposed a linear, process model of adoption where he described the five stages of the adoption process as awareness, interest, evaluation, trial, and actual adoption, which was reflected by purchase (see Figure 1). Adopters were distinguished as early adopters and late adopters. Though previous research on

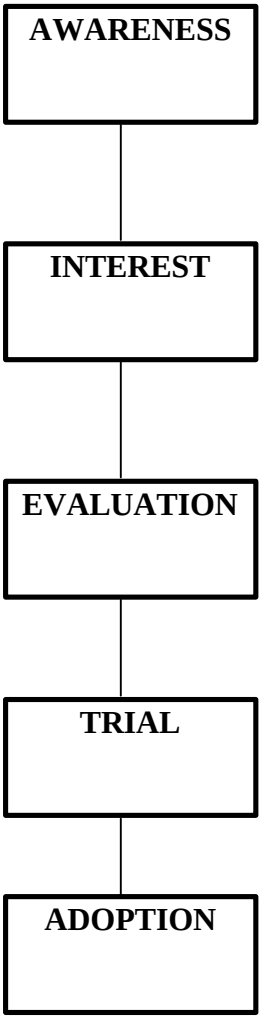

Figure 1. ROGERS' ADOPTION PROCESS

Adapted from Diffusion of Innovations, by E.M. Rogers, 1962, New York: The Free Press.

adoption of technological innovations (Gilly & Zeithaml, 1985) refers to older adults as late adopters, it does not necessarily imply low levels of adoption. A technological innovation was defined as one that possesses some tangible features never found previously in that product class. The microwave oven is a new cooking system altogether with operations that are not found in traditional cooking appliances, rendering it a technological innovation.

Theoretical Model

Carpenter (1988) developed the theoretical model used in this study in a project focusing on microwave oven usage patterns of college students. Based primarily on Rogers' process model of adoption, Carpenter established three levels of adoption of the microwave oven, based on frequency of use compared to the range (see Figure 2). While the empirical model included complexity of food preparation as an indicator of level of adoption, it was not used to identify levels of adoption in data analysis. At the first level, the microwave oven was described as an infrequently used appliance. The second level of adoption reflected the microwave oven as a supplemental appliance to the primary cooking appliance. Finally, the third level of adoption focused on the use of the microwave oven as the primary appliance for cooking. The three levels of adoption were descriptive of the consumers' use of the microwave oven and indicated the extent of adoption. Carpenter emphasized that use of the microwave oven, not necessarily ownership, was a significant indicator of adoption. This varied with Rogers' theory of adoption that indicated that purchase of a product implied adoption. This study focuses on use of the microwave oven to assess levels of adoption. Mere ownership is not considered as a predictor of adoption level.

Acceptance of Innovations

The microwave oven is one of the technological innovations in cooking appliances in the twentieth century. Acceptance and adoption of the microwave oven differs among age groups. Rogers (1962) suggested that adoption was the mental process through which an individual passes from first hearing about an innovation to final adoption. Research indicates that older adults are among the last to adopt new products, services, or ideas (Gilly & Zeithaml, 1985). Gollub and Javitz (1989)

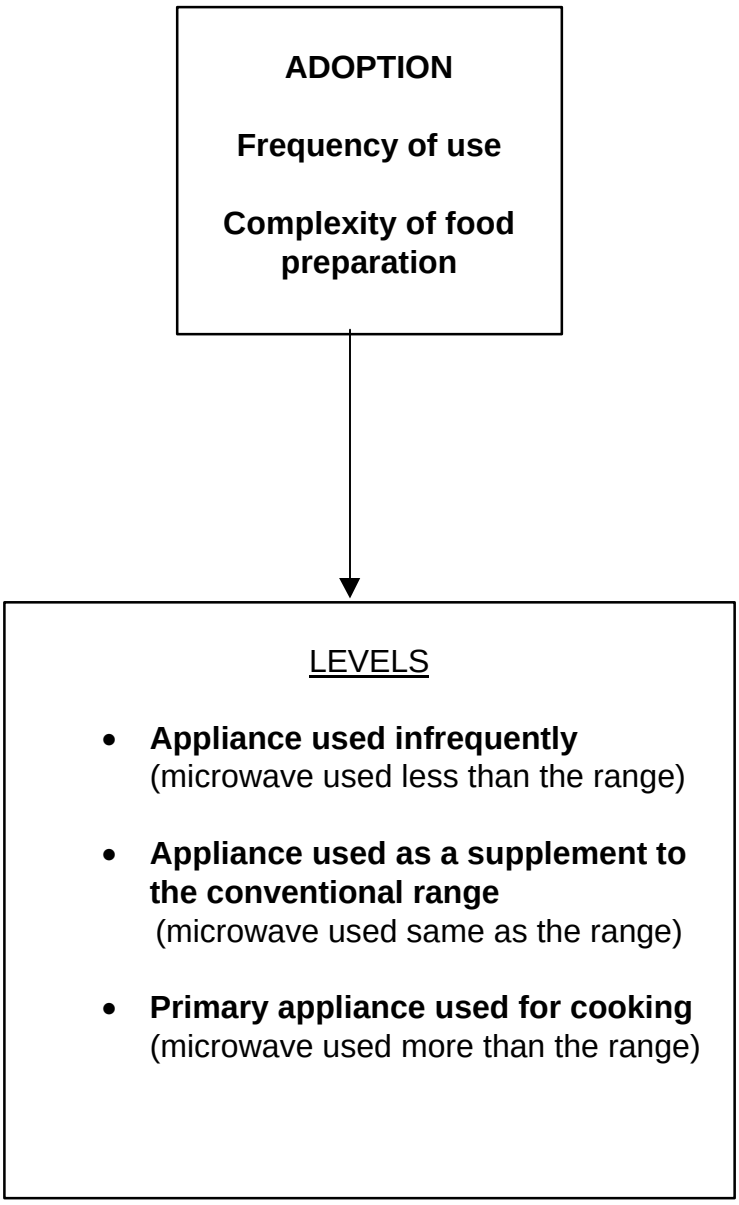

Figure 2. Three levels of adoption of a microwave oven.

From "Microwave usage patterns among college students at Virginia Polytechnic Institute and State University," by S.A. Carpenter, 1988, Unpublished master's thesis, p.11.

emphasized the need for appliance manufacturers to change this very attitude by implementation of clever marketing strategies. Low incidence of use of microwave ovens by older adults could be due to resistance on the part of the elderly consumer to accept technological innovations. Based on Rogers' model, Gilly and Zeithaml (1985) found that the percentage of older adults in later stages of trial and adoption were considerably lower than earlier stages.

Meeks and Sweaney (1993) suggested that microwave oven use was influenced by the innovation index score, presence of children, gender, age, and education. A series of questions regarding the attitudes of the respondents towards change was used to develop the innovation index score. It was more likely for more highly innovative individuals to use all features of the microwave oven than lower innovative individuals. Presence of children in families increased the usage of microwave ovens. Females were found to be more likely to use the microwave ovens to heat leftovers. Older individuals used lower power levels than younger users.

In a study conducted by Beamish and Johnson (1994), Rogers' model of adoption was used to determine acceptance of housing alternatives for the elderly. The four options given were: Elder Cottage Housing Opportunity (ECHO housing), accessory apartments, shared housing, and board and care. Level of innovativeness and acceptance of these housing options were based on "willingness to take a chance." The elderly sample selected were low in the awareness, interest, and evaluation stage, but were willing to consider the options if the situation arose.

Thus, Rogers' model of adoption has been used previously in housing and household equipment research and gives a powerful insight into the acceptance of innovative options and products.

The Elderly Consumer

Several studies in housing indicate that older adults treat their homes as objects of emotional attachment more than financial assets (Borsch-Supan, 1990; Venti & Wise, 1990). The sense of being at home was reported to be enhanced by familiar things around the home (Boschetti, 1990). Similarly, older adults are attached to their older possessions and may resist the entry of innovative appliances into their home.

This could be attributed to an established lifestyle using traditional kitchen appliances and cooking patterns. The microwave oven is a far different cooking system compared to the traditional range or cooktop. Use of the microwave oven in effect means the adoption of a totally new system, which is probably more innovative than the product itself. Considering that the domestic microwave oven has been around for about 35 years or more, one would think that all age segments would easily adopt it. However, there is lack of empirical evidence to suggest the level of microwave oven adoption by older consumers.

Changes in the Aging Process

Several sensory, physical, and cognitive changes accompany the aging process. This has an effect on the ability of older adults to interact and work with household appliances. Haigh (1993) suggested that:

> The user of a product needs to be able to see it, understand it, possibly hear it and probably manipulate it in some way: consequently the most relevant physical capabilities to consider are eyesight, hearing and hand function. Mental abilities are related to information obtained from the interaction of the senses and feedback (p.9).

Wylde (1993) emphasized the need for appliance redesign in the visual, auditory, hand functioning, memory, and cognitive reasoning aspects to meet the wants, requirements, and needs of the "mature market," namely older adults. Also, cooking as an activity of daily living was reported as problematic due to problems with seeing, recall and memory, grasping and gripping, and body flexibility. A table of physiological limitation categories was developed by Carmone, Krauser, and Baker (1984) to depict physiological limitations imposed by the normal aging process (see Table 1). It was emphasized that the process of aging was not a disease but a phenomenon resulting from decreased physiological capacity to withstand everyday stresses.

Visual Acuity

Essential for information perception, vision is also one of the first senses lost with age (Vickers, 1987). Acuity refers to the ability of the eye to see fine details on

Table 1. Physiological Limitation Categories

Physiological Limitation Categories	
1. Vision	decreased speed of focusing on successive images, increased sensitivity to light
2. Hearing	decreased ability to hear, especially at high frequencies
3. Speech weakness	decreased ability to produce the volume of speech necessary for normal communication
4. Dietary needs	decreased ability to taste and distinguish some common substances, increased restriction of certain foods and food additives
5. Manual dexterity	decreased ability to grip and hold
6. Upper extremity weakness	decreased ability to reach, lift, and carry
7. Lower extremity weakness	decreased ability to lift and carry, decreased leg strength
8. Mobility	decreased ability to climb stairs, bend, rise from sitting position
9. Physical/psychological discomfort	decreased ability to discern heat and cold, decrease in reaction time

From “The mature consumer and technology,” by F.J. Carmone, C.K. Krauser, & G.T. Baker, 1984, Advances in Consumer Research, 161, p. 554.

objects sharply. The level of acuity diminishes with age (Haigh, 1993). There were over 2.7 million visually impaired older adults over 65 years of age in 1993, with an estimated 6 million in 2030 (Crews & Frey, 1993). Wylde (1993) suggested that self-reports on poor or fair vision increased with age. Several other changes take place with the eye during aging. The ability to focus on near objects reduces around age 40 and continues to decline (Arthur, 1992). Also, an older adult typically requires three times as much light as a 20-year-old. Haigh (1993) discussed the inability of older adults to distinguish between green and blue due to yellowing of the lens and increased sensitivity to glare. Use of bifocals and trifocals can also affect the ability to read information on the controls and display panel of an appliance. The loss or impairment of vision is a stressor that can actually cause other disabilities – both physical and psychological (Gillman, Simmel, & Simon, 1986).

Wylde (1993) suggested the use of environmental light in addition to artificial sources. Simple, uncluttered panels were recommended, with a logical arrangement of controls. Avoidance of polished chrome was advised to prevent glare and therefore distraction experienced by the user. Larger typeface, combination of upper and lower case to maintain readability, and use of graphic symbols along with verbiage was suggested.

Hearing

Seventy-five percent of older adults have some form of hearing impairment (Havlik, 1986). In the United States, 30% of men between the ages 65 and 74, and 60% age 85 years and older have some hearing impairment. Among women, 18% between the ages 65 and 74, and 44% age 85 and older have some hearing impairment. Aging also affects the ability to interpret and respond to complex auditory information from multiple sources. Higher frequency tones are not heard as easily as lower frequencies. Haigh (1993) indicated lower frequencies should be used for alarms and urgent messages. Rauch and Lovingood (1987) conducted a focus panel study to evaluate the controls on electric ranges for use by older adults. An intermittent beeping alarm was preferred to the traditional buzzer.

Hand Function

Consideration of hand function and its effect on the ability to manipulate and use controls is important. With age, there is a decrease in strength, dexterity, precision, coordination, joint mobility, and sensitivity (Haigh, 1993). Also, diseases such as arthritis can affect the ability to freely use one's hands. Ninety-seven percent of persons over 60 years of age in America have some form of arthritis (Arthritis Foundation, 1976). This condition affects the hand and finger joints making simple activities very difficult and painful. Voelz and Hunt (1987) found that difficulty in turning was the most common hand limitation reported by arthritic patients. Grasping, pushing, and pulling were also reported as difficult actions. The findings indicate that less force is exerted in turning small knobs than larger ones. Kanis (1993) compared the force exerted by a group of users with, and another group without, hand impairments. Pushing was found to be preferred to rotating when using controls. Thus, touch controls may be easier for older adults to use than rotary dials.

Cognitive Changes

Apart from normative physical changes, cognitive and mental abilities decline with age. Memory loss, disorientation, slow reaction time, difficulty in multi-tasking, and decreased information processing skills make it difficult for elderly users to interact with and use household appliances (Haigh, 1993). Ergonomic design of appliance systems is proposed to compensate for the cognitive limitations of the user. Though automation of tasks may minimize functional limitations, further technological innovation in appliances could cause increased confusion, reduced usability, and greater resistance in acceptance by older adults (Pickett, 1988).

Psychological Aspects

In a study on Lifestyles and Values of Older Adults (LAVOA), sponsored by the National Association for Senior Living Industries, Gollub and Javitz (1989) surveyed 3600 persons over the age of 55 to identify psychological factors that influence preferences. The factors identified were conceived as four continuums and designated as:

1. Autonomy-dependence reflected the degree to which they were driven to be on their own.
2. Introversion-extroversion influenced socialization thereby influencing consumer choices.
3. Self-indulgence – self-denial affected product purchase decisions.
4. Resistance to change-openness to change influenced consumer action.

Based on these factors, older adults were categorized into six distinct psychographic segments namely, a) explorers, b) adapters, c) pragmatists, d) attainers, e) martyrs, and f) preservers. Each segment reflected different ideologies on living preferences after retirement and consumer decisions. The same is probably true when it comes to adopting innovative home appliances like the microwave oven.

Related Research

The Special Needs Research Center at the University of Northumbria conducted product evaluations with older adults. Employing methods of task analysis, Sandhu (1993) conducted a user-based evaluation study of microwave cookers (ovens). The entire task of using the microwave was divided into a series of steps and the appliance was evaluated at each stage. Ease of use, comfort, ease of instruction comprehension, effort to perform the task, ease of cleaning, effectiveness of signals, colors, and contrasts, lettering, and illumination levels were considered for overall evaluation of the microwave cookers. Results indicated difficulty due to confusing visual displays, awkward controls, low levels of illumination, and poor audible feedback.

Recommendations were made to appliance manufacturers for rectification. Sandhu's study clearly implies that a major reason for low incidence of use of microwave ovens among older adults could be due to poor design and comprehensibility. However, results do not indicate reasons for adoption or use of the microwave oven by this target group.

Selection of appropriate appliances based on one's physical limitations was suggested as a useful strategy for increasing functional ability for older consumers (Olson, 1988). In a study conducted at the University of Minnesota, Olson developed a matrix of appliance features and characteristics of user disabilities that serves as a

useful tool in appliance selection. Panel members from geriatrics, housing design, appliance design, occupational therapy, and rehabilitation rated appliance features for usability by persons with different disabilities. Nine categories of disabilities were selected: general weakness, limited reach when standing, impaired mobility, difficulty with bending or kneeling, dizziness when looking up, weak or painful grasp, and some vision loss. Appliances were categorized by different models available, highlighting the features of each. This matrix method is proving to be effective in selecting appliances based on physical limitations. It also could be effective in selection of microwave ovens by older adults with specific physical limitations.

In a human factors analysis study conducted by Czaja, Weber, and Nair (1993), physiological demand associated with personal and instrumental activities of daily living were assessed among older adults. Participants were observed during meal preparation and while using appliances. The tasks of meal preparation were reported to be most problematic for the participants due to the disparities between personal capacity and task demand. It was suggested that controls on appliances should require minimum strength to operate, to make it easier for older adults.

Microwave Oven: Use and Satisfaction

A totally new cooking system in the 1960s, the microwave oven has reached the homes of 90% of Americans today (Whirlpool, 1998). In addition to the United States, microwave ovens are fast penetrating the global market. Table 2 indicates saturation levels of microwave ovens all over the world. As the saturation level of microwave ovens increases globally, it would be interesting to observe microwave oven usage among different age groups across the world. The popularity of microwave ovens could be attributed to reduced cooking time, convenience in preparation and clean up, assorted features and sizes, and affordability. Microwave ovens are available with a wide range of features and in a wide range of costs. This ensures adequate choice and makes the appliance affordable.

Freeman (1982) conducted a study to examine the factors influencing the decision to purchase a microwave oven and to identify characteristics of the consumers. The study reported speed of cooking, convenience, and cooler cooking as the most

Table 2. Saturation levels of microwave ovens across the world

Country	Saturation
USA	89%
Japan	87%
Canada	83%
Finland	80%
Australia	65%
New Zealand	65%
Sweden	59%
United Kingdom	53%
Norway	51%
Korea	51%
Austria	49%
Germany	48%
Ireland	46%
France	45%
Netherlands	45%
Belgium	41%
Spain	37%
Hong Kong	36%
Denmark	32%
Singapore	28%
Taiwan	26%
Switzerland	23%
Thailand	23%
Brazil	18%
Argentina	16%
South Africa	16%
Russia	15%
Portugal	13%
Italy	11%
Malaysia	8%
Mexico	5%
Greece	3%
China	3%
Philippines	2%
Turkey	1%

Note. Unlisted countries either had low demand or market data were unavailable.

From “Timesmart Newsletter”, Whirlpool Corporation, 1998.

important characteristics desired. The purchase of microwave ovens was influenced by the availability of features and comparison-shopping. Though income had no significant relation to cost of the microwave owned, age did have a significant effect. Younger consumers sought the convenience of microwave cooking more than older consumers. Carpenter (1988) focused her research on microwave usage patterns among college students. Results show that all participants in the study were satisfied with foods prepared in the microwave oven.

Meeks and Sweaney (1993) studied the factors influencing the use of microwave ovens and suggested that older consumers use the microwave oven for more intense operations in meal preparation than younger adults. In addition, it was reported that the increase in complexity of use resulted in fewer respondents performing that task. The five tasks that were studied included: heating water or leftovers, preparation of convenience foods, use of variable power levels, preparation of foods from scratch, and use of programmed controls. However their study did not address incidence of ownership and adoption patterns among older adults. An intergenerational study was conducted by Whirlpool that investigated consumer orientations towards new products and services. Results indicated that older adults consider the microwave ovens as “necessities” (Whirlpool, 1991). However, there are no empirical research or market surveys indicating the percentage of older adults using the microwave oven and the extent of use.

The International Microwave Power Institute (IMPI, 1997) conducted a national survey with 722 participants on consumer attitudes and uses of microwave ovens and products. About 98% of the respondents reported being satisfied with their microwave oven. Price, brand name, wattage, size, presence of turntable, and special features were some of the primary motivators for purchase among consumers. Use of the microwave oven was reported by 52% to be the same as in the previous year while 31% claimed to use their microwave oven more than in the previous year. Over 80% of adult females and 49% of adult males used the microwave oven at least two to three times daily. Microwave ovens were used most often for reheating leftovers, heating water or beverages, defrosting meats, popping popcorn, preparing entrees, and baking

potatoes. Meats and bread were least often prepared or cooked in the microwave oven.

Summary

The high saturation level of microwave ovens clearly indicates its presence in a majority of the homes today. However, ownership of the microwave oven does not necessarily imply use. Discrepancies in the usage patterns of microwave ovens also exist. Though some research indicates that older adults perform intensive tasks with the microwave (Meeks & Sweaney, 1993), there is no indication of the percentage of older population that does so.

Further research is needed to indicate the incidence of ownership and microwave oven usage patterns among older adults. This would determine the extent of adoption of the microwave oven in the homes of older consumers today. Information regarding behavior of older adults towards innovative products like the microwave oven could be of great significance to appliance manufacturers. They could redesign and develop models that would suit the needs of older adults and increase sales within this target group. It would also help marketers as it reflects the change in adoption patterns of any technological product, in general, by older adults. Harrington (1992) reported that due to the high saturation level of microwave ovens, the market had no place to grow. Targeting older consumers and their needs could definitely be an area for expansion.

CHAPTER III
METHODOLOGY

The purpose of this chapter is to report the specific research questions of this study, the design and development of the empirical model, the development of the instrument, and sample selection, as well as data collection and data analysis procedures.

Research Questions

The study was designed to answer the following questions to determine the extent of adoption of the microwave oven by older adults.

1. Do older adults use the microwave oven more often than the range for meal preparation?
2. What is the level of complexity of food preparation by older adults using microwave ovens?
3. What are the levels of adoption of microwave ovens among older adults?
4. Are older adults satisfied with the microwave oven in terms of cooking speed, convenience, and quality of food?
5. Do older adults desire to continue using microwave ovens in their present and future residences?

Operational Definitions

To facilitate understanding, certain terms used in the study are operationally defined in the context of their use.

Adoption: refers to the extent to which the microwave oven has been incorporated in the household for meal preparation. The level of adoption is a function of frequency of use in comparison to the range (inclusive of surface burners and/or range oven) and complexity of food preparation.

Frequency of use: refers to the usage of the microwave oven in comparison to the range and categorized as more than the range, same as the range, and less than the range.

Complexity of preparation: refers to the degree of complication involved in preparing a particular food. Complexity is categorized as:

- Low : heating small quantities of water,
- Medium-low: reheating,
- Medium: partial preparation (melting butter, chocolate, defrosting)
- Medium High: preparing microwaveable food products,
- High: complete preparation from raw materials to finished food product.

Satisfaction: refers to the extent to which the user is satisfied with the use of the microwave oven. Categories include satisfaction with cooking speed, convenience of use, and quality of food.

Future use: refers to the intention and desire of the user to continue using the microwave oven in the future.

Empirical Model

Based on Carpenter's theoretical model, an empirical model was developed for this study (see Figure 3). This model depicts the variables involved in the study. User characteristics and microwave oven characteristics were the primary independent variables perceived as influencing the dependent variable: level of adoption, which is measured by two variables: frequency of use and complexity of food preparation. Level of adoption and satisfaction are interrelated since they could influence each other. High satisfaction could lead to a higher level of adoption, and higher adoption could result in higher satisfaction. Satisfaction with microwave oven use was related to the decision to use the appliance in the future.

User Characteristics

The user plays a significant role in the entire process of microwave oven choice, use, and satisfaction. The components that were studied included demographic information such as age, gender, marital status and personal characteristics such as visual acuity, hearing, hand function, knowledge of use of the microwave oven, and years of experience. All of these variables were recorded based on the user's self-

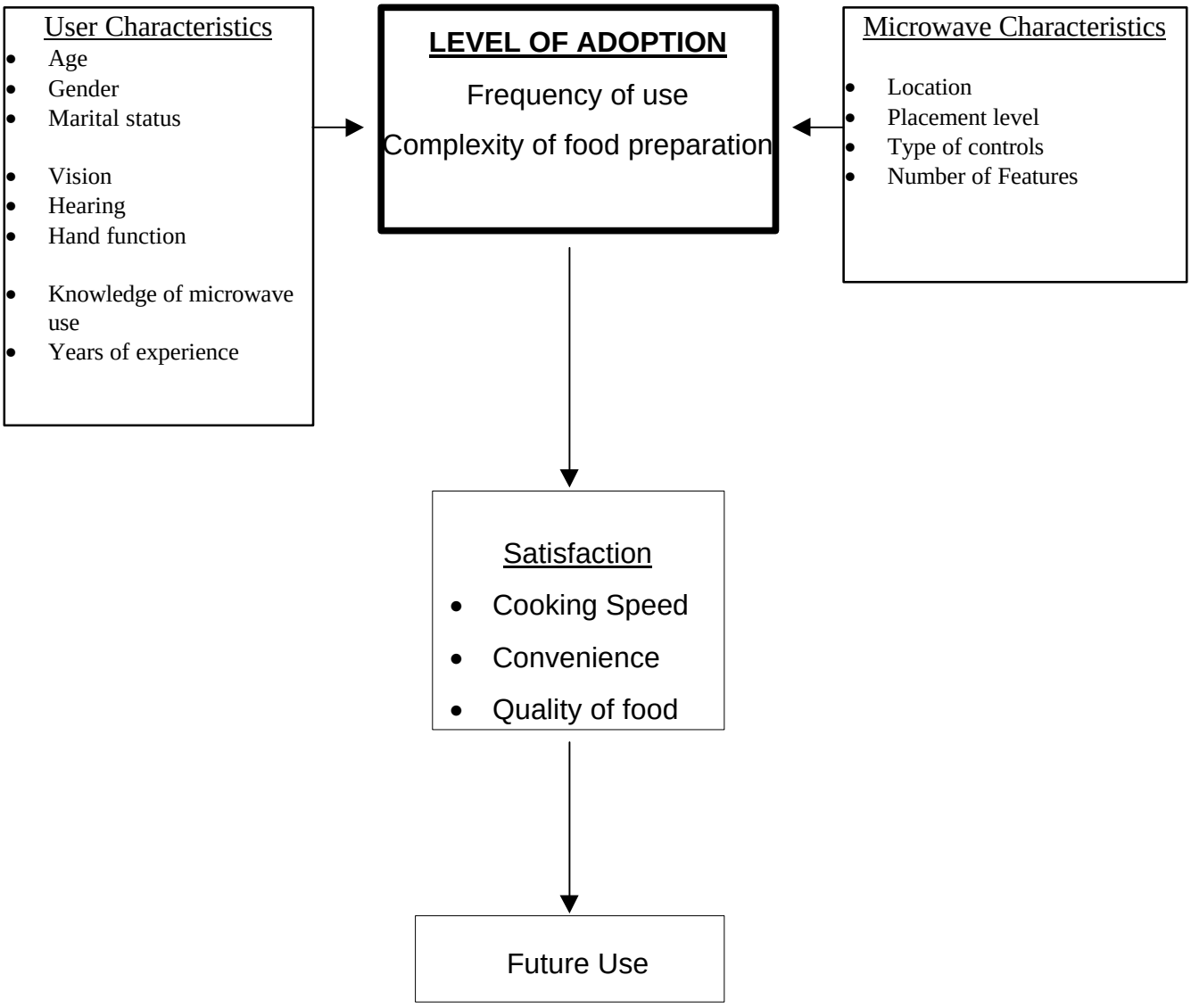

Figure 3. Empirical model of extent of adoption of microwave ovens.

report and assessment.

Microwave Oven Characteristics

The particular microwave oven that is used by the consumer could affect the frequency of use, usage patterns, satisfaction, and decision to continue use in the future. The components that were measured included location and placement level, type of controls, and the number of features of the microwave oven.

Level of Adoption

This variable indicated the extent to which the microwave oven had been incorporated into the meal preparation activity by the older user. The level of adoption was based on the frequency of use in comparison with the range and complexity of food preparation.

Frequency of use. This variable indicated whether the microwave oven was used more or less than the range. This variable was divided into three categories, ranging from least frequently used to most frequently used.

i) Low frequency: used less than the range

ii) Medium frequency: used same as the range

iii) High frequency : used more than the range

Use of the microwave oven “more than the range” indicated that the microwave was used a greater number of times than the range and not necessarily for a greater amount of time.

Complexity of food preparation. This variable indicated the nature of tasks performed with the microwave oven, namely, types of food prepared. It was divided into five categories, ranging from low to high complexity.

i) Low: heating small quantities of water

ii) Med-Low: reheating

iii) Medium: partial preparation (like melting butter, chocolate, defrosting)

iv) Med-High: preparing microwaveable food products

v) High: complete preparation from raw materials to finished product

Determining Level of Adoption

The main question that this study was attempting to answer, level of adoption,

was defined as a function of frequency of use and complexity of preparation. The respondents were categorized into three possible levels of adoption.

i) High adoption

ii) Medium adoption

iii) Low adoption

Cross-tabulation between frequency of use and complexity of food preparation was carried out to identify these three levels of adoption. Shown in Figure 4 is the cross-tabulation of frequency of use and complexity of food preparation.

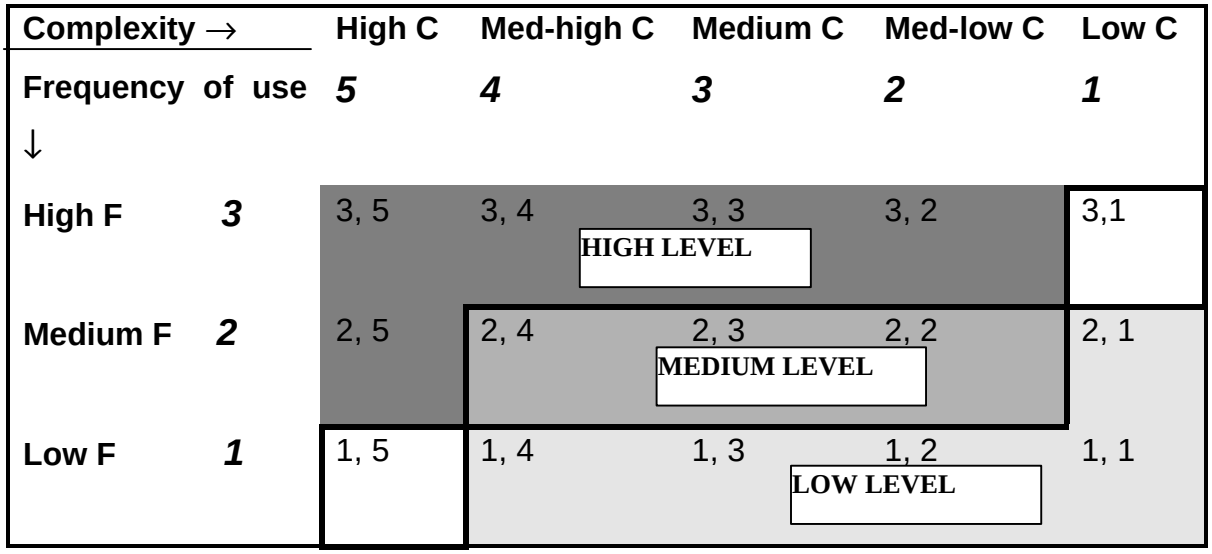

Figure 4. Cross-tabulation of complexity of food preparation versus frequency of use in comparison to range.

The respondents were assigned to the blocks based on their responses to the telephone interview. A person that responded saying that he/she used the microwave most often to reheat leftovers (coded as 2) and used the microwave about the same as the range (coded as 2), was assigned to the block with the coordinates (2,2).

Definition of the three levels was determined by the researcher as:

High adoption: respondents belonging to (3, 5), (3, 4), (3, 3), (3, 2), and (2,5)

Medium adoption: respondents belonging to (2, 4), (2, 3), and (2, 2)

Low adoption: respondents belonging to (2, 1), (1, 4), (1, 3), (1, 2), and (1, 1)

Persons falling in the blocks (3, 1) and (1, 5) were disregarded since they presented conflicting data; i.e., high frequency but low complexity, or low frequency and high complexity. Therefore, the person assigned to the block with coordinates (2,2) would be identified as a medium adopter.

Hypotheses

Based on previous research and results, the following hypotheses were tested.

Ho1: There is a significant relationship between level of adoption of the microwave oven and user characteristics such as

i) age,
ii) gender,
iii) marital status,
iv) visual acuity,
v) level of hearing,
vi) hand function,
vii) knowledge of microwave use,
viii) years of experience.

Ho2: There is a significant relationship between level of adoption of the microwave oven and user characteristics such as

ix) location,
x) placement level,
xi) type of controls, and
xii) features.

These hypotheses were tested to establish or dismiss significant relationships between the variables in the study.

Development of the Instrument

A 33-item questionnaire was developed to serve as the instrument for data collection and included questions to obtain demographic data like age, gender, education, and previous occupation, personal characteristics and capabilities, microwave ownership questions, microwave usage patterns, satisfaction levels and future purchase decisions (see Appendix A). The instrument was pre-tested with a

convenience sample of 10 older adults, all of whom were over 65 years of age, owned a microwave oven, and were the primary users of the microwave oven in their home. Pre-testing was done through telephone interviews. The researcher made observations from the pre-test and the instrument was revised prior to data collection.

Selection of the Sample

A target sample of 75 participants was required for this study. These respondents were randomly selected from a listing of approximately 450 retired personnel in the 1997-98 Virginia Polytechnic Institute and State University faculty and staff directory. A specific process was determined to obtain 75 interviews from the entire listing. All non-local names and numbers were eliminated from the list, which reduced the list to 369 names. Then, a positive response rate of 60% was estimated. In order to obtain 75 eligible participants, a list of 125 names was needed (75/0.6 = 125). To get 125 names from the pool of 369 names, one in every three names was selected (369 /125 = 2.95 or 3).

A random number was selected to determine the starting point. The random number was seven and the seventh name on the list was marked off as the first possible participant. From that point onward, every third name on the list was selected. (This did not include the non-local names and numbers which had already been eliminated.) This method yielded a final list of 128 names. A letter was sent to all 128, informing them of the study and asking them to expect a telephone call between March 16th and March 26th, 1998 (see Appendix B). This was done to give the selected sample the choice to participate or not. The researchers' telephone number and e-mail address were included in the letter and the participants were given the option to contact the researcher if they did not wish to participate in the study or did not meet any of the required criteria. Eligibility for participation was determined using the following criteria:

i. the respondents had to own a microwave oven in their present residence,
ii. be the primary or co-primary user of the microwave oven, and
iii. should have been born in or before 1933.

If the participant mentioned a spouse was the primary user, the spouse was interviewed provided the "age" criterion was met. Elimination of participants due to

unmet criteria was carried out as a part of the process.

Data Collection

Before data were collected, permission was obtained for interviews with human subjects from the Institutional Review Board at Virginia Tech (see Appendix C). The participation of the subjects was entirely voluntary. Data were collected from 10:30 AM-12:30 PM and 6:00 PM-8:00 PM, Monday to Saturday from March 16th to 26th, 1998.

A total of 128 letters had been sent to the randomly selected sample of older adults residing in Blacksburg, Virginia. Each number was called a maximum of five times, on different days, for a response, after which the person's name was taken out of the sample list. In case an answering machine came on, a message was left stating the purpose of the call. In case the respondent did not reply to the message, the person was called again. However, a second message was not left.

A summary of the process of obtaining 75 completed interviews is shown in Table 3. Of the 128 selected participants, 11 sent an e-mail to the researcher indicating ineligibility or inability to participate, 8 left a message on the researcher's answering machine, and 5 letters were returned in the mail. Therefore, a total of 104 telephone calls were made of which two numbers were disconnected.

The researcher did not obtain positive responses from the first 75 respondents on the list. After reaching the end of the list, 12 interviews were still needed to obtain the target sample of 75. The researcher had to go through the entire list and then restart by calling the persons that could not be contacted on the first call in order to obtain 75 completed interviews.

Of the 102 calls that were made, 14 respondents were ineligible to participate, 1 refused to participate, and 12 respondents could not be contacted during the interview period. Of the respondents who were ineligible to participate, 9 were below 65 years of age, 4 indicated that they were neither primary nor co-primary users, and 1 respondent reported absence of microwave oven ownership. After obtaining 75 interviews, the researcher did not try to contact any more respondents. Of the 12 respondents that could not be contacted during the interview period, 9 had messages left on their

Table 3

Summary of the Selection Procedure for Obtaining 75 Completed Interviews

Description	N
Directory listing	450
After eliminating non-local numbers	369
Estimated response rate	60%
Target Sample	75
Number of respondents required	125
Letters sent out	**128**
Respondents eliminated	
E-mails indicating ineligibility or inability to participate	11
Messages on researchers' answering machine	8
Returned mail	5
Total left out of sample	**24**
Remaining respondents who were called	**104**
Further elimination	
Disconnected numbers	2
Refusal	1
Ineligible	14
Unable to contact during interview period	12
Total	**27**
Total interviews completed	**75**

Note. N = number of respondents

answering machine. Three respondents did not have an answering machine and therefore could not be contacted at all. Of the 9 respondents who received the message on their answering machine, 7 called back but were not interviewed for the study as 75 completed interviews had already been obtained.

In case the selected respondent was not the primary user, the researcher asked to speak to the primary user, who in all cases was the spouse. Of the 75 completed interviews, 41 interviews were completed by the selected persons on the list, and 34 interviews were completed by the spouse. Of the 34 spouses, 33 were wives, while in 1 case the husband was the primary user. All interviews lasted about 10-15 minutes.

As anticipated, the response rate was high (58.6%). This could be due to the fact that the sample was selected from a directory listing of retired personnel from Virginia Polytechnic Institute and State University. Being retired employees, their willingness to participate in research being conducted at the university was apparent. The respondents were given full freedom to choose to participate in the study or withdraw at any time. All respondents but one who did not wish to participate called the researcher and asked to be removed from the sample pool.

Data Analysis

Each interviewee was assigned an identification number so that the researcher could contact the person for further questioning or clarification on certain responses. Prior to data entry, a coding list was developed as a part of the questionnaire to help ease data entry (see Appendix A). After 75 interviews were obtained, data were entered into the computer using the Statistical Package for Social Sciences (SPSS) computerized statistical package.

Descriptive analysis was carried out to get a clear picture of the demographics. Frequencies and percentages were computed for all variables and organized into tables. Performing cross-tabulation between frequency of use and complexity of food preparation identified levels of adoption. The proposed hypotheses were tested at 0.05 level of significance using analysis of variance (ANOVA). Tukey's post-hoc tests were to be carried out for significant relationships to identify which groups were different from each other.

CHAPTER IV
RESULTS AND DISCUSSION

Introduction

Descriptive information on microwave oven usage patterns among older adults in Blacksburg, Virginia, is presented in this chapter. In keeping with the purpose of the study, levels of adoption were identified for the respondents. Proposed hypotheses were tested for significance using analysis of variance.

Demographic Description of Subjects

Several questions were asked to obtain demographic information from the respondents. They were given the freedom to choose to answer or not answer any of the questions. The demographic information has been summarized in Table 4. Of the 75 respondents, 33 (44%) were males and 42 (56%) were females. The age of the respondents varied from 65 to 83 years (Mean=70.56 years). They were categorized into age groups for ease of data presentation. Nearly 75% of the respondents were under 75 years of age and belonged to the young-old category. One respondent refused to reveal his age.

A cross tabulation between marital status and number of members in the household reveals that of the 5 respondents who were “never married”, 4 were living alone (see Appendix D). However, one respondent who was “never married” and one respondent who was “previously married” were living with an unrelated person. (The incidence of home sharing could have been observed further with a larger sample.) Not a single married respondent was living alone. Only 6 of all 75 respondents were living with children and spouse. Nearly 72% of the respondents were “currently married” and living with their spouse. Only 25% of the respondents lived by themselves.

Of the 33 males, 6 lived alone and were the primary users, 26 lived with their respective spouses and were co-primary users along with their wives, and 1 lived with wife and children. Of the 42 females, 13 lived alone, 24 lived with their spouse, and 5 lived with their spouse and children (see Appendix E).

Table 4

Demographic Description of the Respondents

Description	N	%
GENDER		
Males	33	44
Females	42	56
Total	75	100
AGE GROUP (Mean=70.56)		
65 – 69	29	39
70 – 74	2	35
75 – 79	12	16
80 - > 80	7	9
Did not disclose	1	1
Total	75	100
EDUCATIONAL STATUS		
<High school	2	3
High School	4	5
< College	2	3
3-year college	1	1
Diploma/certificate	1	1
Bachelors degree	13	17
Masters degree	16	21
All but dissertation	1	1
Doctoral degree	35	47
Total	75	100

Description	N	%
MARITAL STATUS		
Currently married	54	72
Previously married	16	21
Never married	5	7
Total	75	100
HOUSEHOLD SIZE (Mean=1.84)		
1 member	19	25
2 members	50	67
3 members	5	7
4 members	1	1
Total	75	100
PREVIOUS OCCUPATION		
Professor	41	55
Home-maker	24	32
Secretary	3	4
Registered nurse	2	3
Librarian	2	3
Administrator	1	1
Explorer	1	1
Electrician	1	1
Total	75	100

Note. All percentages have been rounded to the nearest whole number.
N = number of respondents.

Since the sample pool for this study was randomly selected from the directory of retired personnel of Virginia Polytechnic Institute and State University, a high educational level was not surprising. Nearly 47% of the respondents had a doctoral degree, 21% had a master's degree, and 17% had a bachelor's degree.

The respondents were also asked questions pertaining to their previous occupation. Over half (55%) of the respondents reported that they were retired professors from the university. The location of the sample in a university town could be the reason for high educational status and the nature of previous occupation. Seven among these retired professors said that they were still involved with research at the university. Of the remaining 65%, 32% did not consider themselves retired as they were still "home-makers" and had been that all their lives.

Current Microwave Oven Ownership

Information regarding the current microwave oven ownership situation in the households of the respondents is compiled in Table 5. About 95% of the households owned only one microwave oven. However, four households owned two microwaves in the same residence. The age of the current microwave oven owned ranged from less than a year to over 20 years. Nearly 41% had owned their current microwave oven from five to nine years. Judging from the low percentages that had owned the microwave oven for less than a year, it can be assumed that the microwave oven was no longer an innovative appliance for the majority of the respondents

When asked about how they had acquired their microwave oven, 72% said that they had purchased it themselves, 27% had received it as a gift from their children, and 1% indicated that it came with the house. The high percentage of self-purchase indicates that these older adults are willing to spend for an innovative product such as the microwave oven. The 27% that had received it as a gift mentioned that they would never have bought one.

All of the 75 respondents kept their microwave in their kitchen. However, there were variations on where it was placed in the kitchen. Nearly 67% of the respondents had the microwave oven on the countertop, 17% had it over the range, 8% had it built-in, 4% placed it on a separate cabinet, and 4% kept it on a table. The high percentage

Table 5

Characteristics of Microwave Oven Ownership

Description	N	%
OWNED MORE THAN ONE		
Yes	4	5
No	71	95
Total	75	100
LENGTH OF OWNERSHIP		
Less than 1 year	3	4
1 - 4 years	20	27
5 - 9 years	31	41
10 - 14 years	13	17
15 - 19 years	5	7
20 and over	3	4
Total	75	100
ACQUISITION		
Self-purchased	54	72
Gift	20	7
Already present in house	1	1
Total	75	100
LOCATION		
Kitchen	75	100
Total	75	100
PLACEMENT		
On the countertop	50	67
Over the range	13	17
Separate cabinet	3	4
On a table	3	4
Built-in	6	8
Total	75	100
IN RELATION TO EYELEVEL		
Controls at eye level	15	20
Controls below eye level	53	71
Controls above eye level	7	9
	75	100
TYPE OF CONTROLS		
Touch control panel	64	85
Rotary dials	7	9
Touch and dials	3	4
Slider control	1	1
Total	75	99

Note. Percentages have been rounded to the nearest whole number. Some totals may not add to 100 % due to rounding. N = number of respondents.

of respondents that placed the microwave oven on the countertop could imply that the microwave oven is still considered an add-on in the kitchen rather than a permanent and necessary appliance. Those that reported it to be built-in had remodeled their kitchens and planned for placement of the microwave at eye level. It was not surprising to hear that nearly 71% felt that the control panel of their microwave was located below their eye level considering that 67% had it on the countertop.

When asked about the type of controls that their microwave oven had, 85% reported having touch controls, 9% had rotary dials, 4% had a combination of both, and 1% had an old microwave with a slider control. All respondents on their second or third microwave oven had chosen one with touch controls.

Previous Microwave Oven Ownership

In order to get an idea of the level of experience that the respondents had with microwave ovens, questions were asked regarding number of microwave ovens owned before, number of years since they very first used a microwave oven, and reasons that prompted them to start using it (see Table 6).

Nearly 44% of the respondents had not owned a microwave oven prior to their current one. However, a sizeable proportion (39%) had owned one microwave before their current model, 13% had owned two, 3% had owned three, and 1% had owned four microwave ovens previously. The high percentages of previous microwave oven ownership reflect the importance placed on the microwave oven by older adults in this community.

When asked about the number of years since they first started using a microwave oven, 12% of the respondents reported 20 years, 27% reported 15 to 19 years, 37% said that they had used it between 10 and 14 years, and 23% of the respondents said they had used it for less than 10 years. These findings indicate that this group of older adults had used the microwave oven for several years. Some respondents replied to this question by saying that they had used it ever since microwave ovens became popular. At the same time, they also mentioned that they had been using it for 10 years, implying that they believe microwave ovens have been a popular appliance only for the last 10 years. It was apparent that several

Table 6
Characteristics of Previous Microwave Oven Ownership

Description	N	%
NUMBER OWNED BEFORE		
None	33	44
One	29	39
Two	10	13
Three	2	3
Four	1	1
Total	75	100
NUMBER OF YEARS OF USE		
Less than 5 years	5	7
5 – 9 years	12	16
10 – 14 years	28	37
15 – 19 years	20	27
20 – 30 years	7	9
Over 30 years	2	3
Cant remember	1	1
Total	75	100
REASONS FOR FIRST STARTING TO USE IT		
Convenience	35	47
Gifted by children	19	25
Speed of cooking	16	21
Good for defrost & reheat	12	16
Usefulness to friends and relatives	8	11
Remodeled kitchen	4	5
Its popularity	4	5.
New gadget	2	3
Rental house had one	1	1
Forced into it	1	1
Total	75	100
KNOWLEDGE OF USE		
Knows all operations	19	25
Knows regular operation	50	67
Knows limited operation	6	8
Total	75	100

Note. Percentages have been rounded to the nearest whole number.
The respondents were allowed to give as many reasons as they wanted for starting to use the microwave oven.
N = number of respondents.

respondents felt that they had adopted the microwave oven when it was considered a new appliance. However, the years of use indicate differently. This could be due to late adoption of the microwave oven by older adults in this community.

Interesting answers were obtained when the respondents were asked for reasons that prompted them to start using the microwave oven. The most frequent answer was “convenience” by 47% of the respondents. Nearly 25% of the respondents very honestly admitted that the main reason for them to start using the microwave oven was because it was a gift from their children and they did not want to offend their children by not using it. Speed of cooking (21%), easy defrosting and reheating (16%), and the mention of its usefulness from friends and relatives (11%) were other common answers. One respondent vehemently stated that she was forced into it by her husband and children and would not have tried it if given the choice!

The respondents were also asked about their knowledge of using microwave ovens. They were not tested on knowledge but were asked to report self-perceptions. Nearly 67% of the respondents admitted to knowing only those operations that they used on a regular basis. For all other operations they had to refer to the manual or a recipe. Of the remaining, 25% reported that they knew the operation of all the features on their microwave oven and did not need to refer to the manual and only 8% reported that they knew very limited operations with their microwave oven. Of the 67% who knew only day-to-day operations, 70% did not feel the need to learn to use those features that they would, in effect, never use. This attitude is mainly due to the fact that the microwave oven has established itself as an appliance to perform certain tasks in each household. The respondents were satisfied and content with using the microwave oven for those established tasks and did not perceive the need to learn about other possibilities. Hence, the indifference towards knowledge of all features of their microwave oven.

Features on Current Microwave Ovens

The respondents were asked questions regarding the different features that were on their current microwave oven (see Table 7). Nearly 93% of their microwave ovens had a timer, 89% had variable power levels, 89% had a clock, 83% had a

Table 7

Features on Microwave Ovens Currently Owned

Features	N	%
Timer	70	93
Variable power levels	67	89
Clock	67	89
Auto defrost(PC)	62	83
Auto reheat(PC)	40	53
Popcorn (PC)	28	37
Meat(PC)	26	35
Vegetables(PC)	23	31
Beverage(PC)	16	21
Other (timetable/memory/turntable)	16	21
Variable temperature levels or probe	16	21
Convection	10	13

Note. The respondents were asked to indicate any number of features that they had on their current microwave oven. Percentages have been rounded to the nearest whole number.
N = number of respondents.

programmed control for auto-defrost, 53% had a programmed control for auto-reheat, 37% had a touch control for popcorn, 35% had a touch control for meat, and 31% had a touch control for vegetables. About 21% of the respondents had other features such as a timetable, memory, and turntable. About 21% had variable temperature levels or temperature probe, and 13% had convection microwave ovens. At least 50% of the microwave ovens had two programmed controls: auto-reheat and auto-defrost. The low percentages for convection microwave ovens and temperature probes could be a reason why this group still uses the range oven or wall oven for baking and roasting.

Features Desired in Future Microwave Ovens

After asking about the features present on the current microwave oven, the respondents were asked to indicate features that they would look for in future microwave ovens that they might purchase (see Table 8). The respondents were not given a list to choose from but were asked to answer this question based on their perception of need. Nearly 35% of them indicated the need for a carousel or turntable.

Twenty-three percent seemed quite satisfied with the features on their current microwave oven and wanted the very same kind. While 7% of the respondents emphasized the desire for simple controls, about 3% indicated the need for programmed controls. Larger size (3%), popcorn touch control (3%), browning element (1%), more speed (1%) and ease (1%) were some other features desired. A little over 21% of the respondents were unsure about the new features available on microwave ovens and did not comment on any specific features.

Meal Patterns

In order to understand the usage patterns of the microwave oven in comparison with other traditional appliances like the range, cooktop, or oven, questions pertaining to meal patterns were asked. The basic idea behind this was to get an idea of what and how many items were eaten for breakfast, lunch, and dinner. A summary of the number of items for each of the three meals is provided in Table 9. A typical day's meal pattern included breakfast with cereal, coffee, and orange juice; a light lunch with soup, sandwich, and fruit; and a heavy dinner with four to five dishes, usually meat, potatoes, greens, rice or bread, and dessert. The specific foods were not recorded

Table 8

Additional Desired Features on Future Microwave Ovens

Features	N	%
Turn table / carousel	26	35
Same as current microwave owned	17	23
Not familiar with new features	16	21
Simple controls	5	7
Programmed controls	2	3
Larger size	2	3
Popcorn	2	3
Browning element	2	3
More Speed	1	1
More ease	1	1
Total	75	100

Note. The respondents were asked to indicate one feature that they desired in a future microwave oven that they might purchase. Percentages have been rounded to the nearest whole number.
N = number of respondents.

Table 9

Meal Patterns of the Respondents

Description	N	%
Items for Breakfast (Mean = 2.88)		
1	4	5
2 - 3	62	83
4 – 5	7	9
> 5	2	3
Total	75	100
Items for Lunch (Mean = 2.2)		
Eat out	9	12
1	8	11
2 – 3	51	68
4 – 5	6	8
>5	1	1
Total	75	100
Items for dinner (Mean = 3.76)		
1	2	3
2 – 3	32	43
4 – 5	37	49
>5	4	5
Total	75	100

Note. The respondents were asked to give an average number to indicate items prepared for breakfast, lunch, and dinner. Percentages have been rounded to the nearest whole number.
N = number of respondents.

individually for each respondent. The results are based on answers from the majority, but not all respondents.

Microwave Oven Usage Patterns

The purpose of this study was to identify levels of adoption of the microwave oven by older adults. Levels of adoption were operationally defined as a function of frequency of use in comparison to the range and complexity of food preparation. In order to define the levels of adoption, the respondents were asked the number of times they used the microwave oven daily, whether they used it more than the range, what all did they use the microwave for, and what they used it for most frequently. The results from these questions are summarized in Table 10.

About 57% of the respondents used the microwave two to four times a day, 23% used it five to seven times a day, and 11% used it once a day or less. Of the remaining, 8% used it eight to 10 times a day and 1% used it more than 10 times a day. In summary, about 80% of older adults use the microwave two to seven times daily. When asked about frequency of use in comparison to the range, 52% indicated that they used their microwave oven more than their range for day-to-day meal preparation. Surprisingly, only 16% used it as much as the range compared to 32% who used it less than the range. This could indicate that older adults have clear and somewhat rigid perceptions of the use of the microwave oven. The respondents who still use the range more than the microwave ovens may do so as that was how they first learned to cook.

Information about complexity of preparation was obtained by asking the respondents whether or not they used the microwave oven for five different broad-based purposes. Nearly 99% of the respondents used the microwave for reheating, 87% used it for partial preparation such as defrosting, melting butter, or chocolate, 80% used it for heating water for tea, coffee, or soup, and 55% used it for complete preparation of food products from basic raw materials to the final product. An interesting point to observe is that only 39% of the respondents used the microwave for microwaveable food products of any kind. Several respondents mentioned that they did not prefer the use of readymade food products. They preferred the “old-fashioned” method of preparing food.

Table 10

Microwave Oven Usage Patterns

	Description	N	%
FREQUENCY OF USE			
	Once/day or less	8	11
	2 - 4 times/day	43	57
	5 - 7 times/day	17	23
	8 - 10 times/day	6	8
	Over 10 times/day	1	1
	Total	75	100
USE COMPARED TO THE RANGE			
H	More than the range	39	52
L	Less than the range	24	32
M	Same as the range	12	16
	Total	75	100
TASKS			
ML	Reheating	74	99
M	Partial preparation	65	87
L	Heating water	60	80
H	Complete preparation	41	55
MH	Microwaveable food product	29	39
MOST FREQUENTLY USED FOR:			
	Reheating	45	60
	Complete preparation	15	20
	Partial preparation	7	9
	Microwaveable food products	7	9
	Heating water	1	1
	Total	75	99

Note. H = High, MH = Medium-high, M =Medium, ML =Medium-low, L = Low.
Percentages have been rounded to the nearest whole number.
N = number of respondents

After obtaining information about general usage patterns, the respondents were asked to prioritize and select ONE task that they used the microwave oven most frequently for. Nearly 60% of the respondents reported reheating as the most frequent task. About 20% of the respondents used the microwave oven most often for complete preparation of food products. The respondents did not use the microwave as often for partial preparation (9%), microwaveable food products (9%), and heating water (1%). The researcher wanted to record information regarding all possible tasks as well as identify those tasks that are most frequently performed in the microwave oven. Responses to this question were used to determine level of adoption.

Self-perceived Health Condition

The reason for asking the respondents about any perceived difficulty with vision, hearing, or manipulation of controls was to identify any design features that could be changed to enhance usability of the microwave oven for older adults. The specific questions asked were whether the respondent had any difficulty with reading the information on the control panel, any difficulty with hearing the timer, or any difficulty with actually manipulating the controls. Nearly all the respondents indicated absolutely no difficulty with vision, hearing, and hand function. Only one respondent indicated difficulty with reading the information on the panel. The ironical aspect of these findings is that 98% of the respondents wore glasses; 70% wore bifocals, 21% wore trifocals, and 7% wore reading glasses. Since the reports on vision, hearing, and hand function were all self-reported and not measured, they cannot explain any influence on frequency of microwave oven use.

Level of Adoption

Three levels of adoption were identified based on frequency of use compared to the range and degree of complexity of the most frequently performed task on the microwave oven. Figure 5 depicts the level of adoption of respondents based on a cross-tabulation between complexity of food preparation and frequency of use in comparison to the range. Based on the definition of levels of adoption in the model (refer to Figure 4, p. 25), actual figures were calculated and summarized in Table 11. Results indicate that 56% of the respondents were at a high level of adoption, 27%

Complexity →	High C	Med-high C	Medium C	Med-low C	Low C
Frequency of use ↓	*5*	*4*	*3*	*2*	*1*
High F *4*	8	6	2	23	0
Medium F *3*	3	0	2	7	0
Low F *2*	4	1	3	15	1

HIGH LEVEL

MEDIUM LEVEL

LOW LEVEL

Figure 5. Level of adoption of the respondents

Table 11

Level of Adoption

	N	%
High	42	56
Medium	9	12
Low	20	27
Disregarded entries	4	5
Total	75	100

Note. Four entries were disregarded as they represent extreme cases.
Percentages have been rounded to the nearest whole number.
N = number of respondents.

were at a low level of adoption, and 12% were at a medium level of adoption. Four entries were disregarded as they represented extreme cases. From this table, it also can be inferred that medium-low complexity (reheating) most frequently characterized the task that the microwave was used for, followed by high complexity (complete preparation). Also, the table clearly indicates that the number of respondents with high frequency of use (39) was greater than those with low frequency of use (24). It is also interesting to note that respondents in the high or medium frequency category do not perform the low complexity task most often.

Satisfaction with Microwave Oven

Satisfaction was measured in relation to cooking speed, convenience, and quality of food. The information is summarized in Table 12. While 93% of the respondents were satisfied with speed and convenience, only 60% were satisfied with quality of food. Reasons for dissatisfaction were unevenness in cooking meat, toughness rendered to food like bread, quick cooling, unpleasant appearance, and lack of taste in meats. Analysis of qualitative information showed that nearly 90% of the respondents disliked cooking meat of any kind in the microwave oven except fish. Respondents were satisfied with cooking vegetables in the microwave oven.

Satisfaction and Level of Adoption

A cross-tabulation of satisfaction and level of adoption was carried out to observe the nature of relationships between the two variables (see Table 13). Of the high adopters, 100% were satisfied with speed and 98% were satisfied with convenience in use. but only 67% were satisfied with quality of food. However, this shows that the low satisfaction with quality of food does not deter high adopters from using the microwave oven. The same trend was observed with medium and low adopters. It is difficult to determine whether high adoption led to satisfaction or satisfaction with the microwave oven led to high adoption! However allowances are made on the kind of foods they prepare in the microwave oven. While many respondents reported that they were satisfied with vegetables and fish cooked in the microwave oven, nearly 80% mentioned that they never cooked meat in it.

Table 12

Satisfaction with Microwave Oven Among the Respondents

Description	N	%
Satisfaction with speed		
Yes	70	93
Somewhat	4	6
No	1	1
Total	75	100
Satisfaction with convenience		
Yes	70	93
Somewhat	3	4
No	2	3
Total	75	100
Satisfaction with quality of food		
Yes	45	60
Somewhat	24	32
No	6	8
Total	75	100

Note. Percentages have been rounded to the nearest whole number.
N = number of respondents

Table 13

Level of Adoption and Satisfaction with Microwave Ovens

Description	High Adoption N	Medium Adoption N	Low Adoption N
Satisfaction with speed:			
Satisfied	42 (100%)	8 (89%)	18 (90%)
Somewhat satisfied	0	1 (11%)	1 (5%)
Not satisfied	0	0	1 (5%)
Total	42 (100%)	9 (100%)	20 (100%)
Satisfaction with convenience:			
Satisfied	41 (98%)	9 (100%)	17 (85%)
Somewhat satisfied	1 (2%)	0	2 (10%)
Not satisfied	0	0	1 (5%)
Total	42 (100%)	9 (100%)	20 (100%)
Satisfaction with quality of food			
Satisfied	28 (67%)	4 (44%)	12 (60%)
Somewhat satisfied	13 (31%)	4 (44%)	5 (25%)
Not satisfied	1 (2%)	1 (12%)	3 (15%)
Total	42 (100%)	9 (100%)	20 (100%)

Note. Percentages have been rounded to the nearest whole number.
The numbers for satisfaction do not add up horizontally as the disregarded entries are not included in this table.
N = number of respondents.

Future Use and Purchase

Two questions were asked to determine whether these older adults would continue to use microwave ovens in their cooking lifestyle in the future, and whether they would consider purchasing another one (See Table 12). In response to the question about using a microwave oven in future residences, 93% said "yes." Some of the key words they used to describe reasons for use in the future were: "would not do without it," "indispensable to my cooking," and "have to have it."

When asked if they would purchase another microwave oven in the future, 76% replied in affirmation. However, all 76% added that they would purchase another only if the current one "died"! The remaining 24% said that they would not purchase another one because they felt that they were too old and their microwave would probably outlive them. Two among this group also mentioned that the next housing option they would select would provide them with meals and therefore they would not need to use a microwave oven or any other appliance. The respondents were asked to indicate any number of reasons for use/purchase.

Statistical Analysis and Discussion

The proposed hypotheses were tested for statistical significance using One Way Analysis of Variance (ANOVA). A significance level of $p<0.05$ was used. Of the 12 proposed hypotheses, four were eliminated due to lack of variance in the data. Level of adoption was not tested with visual acuity, hearing, hand function, and microwave oven location. For the remaining hypotheses, initially no significance was obtained with any of the variables. In order to further test for significance, groups were collapsed. Tukey's post-hoc tests were to be conducted to identify the groups that are different from one another. However, the presence of only two groups eliminated the need for the post-hoc test.

Results of the hypotheses that were tested are reported below. Table 15 presents a summary of the means, f-ratio, and level of significance obtained with each hypothesis that was tested.

Hypothesis 1(i)

There is a significant relationship between level of adoption of the microwave oven and

Table 14

Future Use and Future Purchase Decisions

Description	N	%
WILL USE IN FUTURE		
Yes	70	93
No	4	5
Don’t care	1	1
Total	75	99
WILL BUY IN FUTURE		
Yes	57	76
No	18	24
Total	75	100
REASONS FOR USE/PURCHASE		
Convenience	48	64
Speed	36	48
Good with vegetables	22	29
Warms but doesn’t dry	13	17
Indispensible	4	5
Simplifies tasks	2	3

Note. The total doesn't add to 100% as the disregarded entries have not been included in this table.
N = number of respondents.

Table 15

Analysis of Variance for Level of Adoption

Independent Variables	Mean	f	p
AGE GROUPS		0.2554	0.6148
< 75 years of age	2.6071		
75 years and over	2.8421		
GENDER		2.1914	0.1431
Males	2.3333		
Females	2.9286		
MARITAL STATUS		4.9124	0.0391*
Currently married	2.6250		
Not currently married	4.20		
KNOWLEDGE		0.534	0.467
Limited	2.1667		
Adequate or maximum	2.7101		
EXPERIENCE		0.138	0.937
Less than 10 years	2.5882		
10 – 19 years	2.6250		
20 years and over	3.0000		
PLACEMENT		0.7943	0.3763
On countertop	3.1538		
Other	2.6400		
TYPE OF CONTROLS		16.2501	0.0001*
Touch controls	2.3906		
Rotary/slider controls	4.7143		
NUMBER OF FEATURES		0.6942	0.2363
Five or less	2.9647		
More than five	2.0125		

Note. Level of adoption was coded as: High = 3, Medium = 2, Low = 1
f=f-ratio from ANOVA, p= level of significance.
* = indicates significant relationship when p< or = 0.05.
age.

Result: No significant difference was found between level of adoption and age (f=0.2554, p=0.6148). Age of the respondent did not have an effect on the level of adoption.

Hypothesis 1(ii)

There is a significant relationship between level of adoption of the microwave oven and gender.

Result: No significant difference was found between level of adoption and gender (f=2.1914, p=0.1431). There was no difference in levels of adoption between males and females.

Hypothesis 1 (iii)

There is a significant relationship between level of adoption of the microwave oven and marital status.

Result: There was a significant relationship between level of adoption and marital status (f = 4.336, p=0.041). Marital status was grouped as currently married and not currently married – included previously married and never married.

Respondents who were either previously married or never married had a significantly higher mean level of adoption (x=4.2) than those who were currently married (x=2.625). The reason for this could be that they lived alone and found it more economical to use the microwave oven for small quantities. Those that were currently married had lower levels of adoption. This can be attributed to the fact that respondents preferred to prepare larger quantities in traditional cooking appliances instead of the microwave oven.

Hypothesis 1(vii)

There is a significant relationship between level of adoption and knowledge of microwave oven use.

Result: No significant relationship was found between level of adoption and knowledge (f=0.534, p=0.467). Limited knowledge of the operation of all features of the microwave oven did not affect the level of adoption.

Hypothesis 1(viii)

There is a significant relationship between level of adoption and years of experience.

Result: No significant relationship was found between level of adoption and years of experience (f=0.138, p=0.937).

Hypothesis 2(x)

There is a significant relationship between level of adoption and placement level of the microwave oven.

Result: No significant relationship was found between level of adoption and placement level of the microwave oven (f=0.7943, p=0.3763).

Hypothesis 2 (xi)

There is a significant relationship between level of adoption and the type of controls of the microwave oven.

Result: There was a significant relationship between level of adoption and type of controls on the microwave oven (f=12.423, p=0.00). Types of controls were categorized as touch controls and "other" controls. Respondents who had other type of controls had a higher level of adoption (x=4.7143) than those respondents who had touch controls (2.3906). Therefore, respondents who had rotary dials and slider controls were higher adopters than those with touch controls.

This could be attributed to the fact that older adults find it difficult to work with complicated panels that have a lot of information on them. It could also be inferred that older adults with these controls have older microwave ovens and therefore may have adopted it more, owing to the fact that they have been using it over a longer period of time.

Hypothesis 2 (xii)

There is a significant relationship between level of adoption and number of features on microwave oven owned.

Result: No significant relationship was found between level of adoption and number of features (f=0.6942, p=0.2363). The number of features was grouped as i) five or less and ii) more than five.

Thus, it was observed that the only significant predictors of level of adoption were marital status and type of controls. The reason for the lack of significance of other variables could be due to sampling error and the small number of respondents in

the sample. However, it is also possible that all predictors were not identified. Characteristics of the population such as consumption patterns, lifecycle stage, previous experiences, and financial situation may be significant predictors. One can also not ignore the possibility of mere convenience of the microwave oven with simple task performance to be a reason for increased use.

Comparison of Findings with Previous Research

Results from this study indicated that a high percentage of older adults who own microwave ovens are high adopters (56%). This could not be compared to previous findings as there is limited research targeting microwave oven use by older adults. Meeks and Sweaney (1993) reported that older adults used the microwave most often for preparing items from scratch. Results from this study indicated that older adults use the microwave most for reheating leftovers followed by complete preparation from raw materials to the final product. Similar to findings pertaining to factors affecting use of microwave ovens by older adults (Freeman 1982), this study reported convenience and speed of cooking to be primary reasons for increased use.

The International Microwave Power Institute (IMPI, 1997) reported that 98% of microwave oven users were satisfied with their appliance and used it two to three times daily. Findings from this study indicated that 93% of the respondents were satisfied with speed and convenience and 57% used it two to four times every day.

Comparing this study with Carpenter's (1988), it appears that the microwave oven has become a popular appliance among young and old alike. Carpenter (1988) reported that students who used the microwave more than their range used it to prepare medium and low complexity foods. This study identified the same patterns. Respondents who used the microwave oven more than the range used it most frequently to perform a medium-low complex task such as reheating. In fact, all levels of adopters used the microwave oven more for the medium-low complexity task. Therefore, it can be interpreted that a combination of frequency of use and complexity of task should be considered together to define and assess level of adoption as in this study. Comparing this study with Carpenter's study, it is observed that the majority of both younger and older adults are satisfied with their microwave ovens most of the

time. About 79% of the students from Carpenter's study and 76% of the older adults from this study affirmed purchase of a microwave oven in the future. The similarities in usage patterns and future purchase decisions among younger and older adults reveals little difference in adoption levels between the two groups.

CHAPTER V

SUMMARY, LIMITATIONS, RECOMMENDATIONS, AND IMPLICATIONS

Summary

The microwave oven has been in the consumer market for over 35 years now. The advantages of using the microwave oven for daily meal preparation are unquestionable. It saves time, is convenient to use, requires low-maintenance, is safe, and affordable. For all these reasons, the microwave oven would be a useful appliance to older adults for meal preparation.

The purpose of this study was to determine the extent of adoption of microwave ovens by older adults. A random sample of 128 older adults was selected from the Virginia Polytechnic Institute and State University directory of retired personnel. Data were collected through administration of telephone interviews. The respondents were interviewed only if three primary criteria were met. The respondent had to own a microwave oven, be the primary or co-primary user of it, and should have been born before 1933. A total of 75 telephone interviews were conducted and analyzed between March 16th and 26th, 1998.

Level of adoption was defined and determined as a function of frequency of use of the microwave oven in comparison to the range and complexity of food preparation. Frequency of use was categorized as:

High - used more than the range,

Medium – used same as the range, and

Low – used less than the range.

Complexity of preparation was divided into five separate categories;

High – complete preparation from scratch,

Medium-high – microwaveable food products

Medium – defrosting, melting butter or chocolate

Medium-low – reheating

Low – heating small quantities of water.

Based on their responses, the respondents were identified as high, medium, or low adopters. Demographic information such as age, gender, marital status, household size, educational background, and previous occupation were determined. Specific information about the microwave oven owned, usage patterns, and plans for future purchase and use were determined. Relationships between level of adoption, user characteristics, and microwave oven characteristics were statistically tested and conclusions were drawn.

Conclusions

Based on the findings, the conclusion is that there is a high level of adoption among the 75 older adults living in Blacksburg, Virginia, who participated in this study. Fifty-six percent of older adults were at the "high adopter" level, 12% were medium adopters, and 27% were low adopters.

With respect to the role of the microwave oven in the lifestyle of these older adults, along with future use and purchase decisions, the following findings are presented.

1) Most of the respondents (95%) had only one microwave oven in their home.
2) The microwave oven is used daily in households of most older adults of this community who own one.
3) Convenience and speed of cooking are the main reasons for use.
4) Most of the older adults have a light breakfast and lunch, and a heavier dinner which is referred to as "the main meal of the day".
5) Fifty-two percent of the respondents use the microwave oven more frequently than the range.
6) Sixty percent of the respondents use the microwave primarily for reheating.
7) Satisfaction with cooking speed and convenience is higher than satisfaction with quality of food cooked in the microwave oven.
8) Ninety-three percent of the respondents will continue to use a microwave oven even in future residences.
9) Seventy-six percent of the respondents will purchase a microwave oven in the future if their current microwave oven "dies."

10) Level of adoption is significantly higher among older adults who were “never” married or were “previously married” than those who are “currently married.”

11) Level of adoption is significantly lower among older adults who have touch controls on their microwave oven compared to those with rotary dials or slider controls.

Discussion

This study targeted older adults 65 years and older to assess extent of adoption of the microwave oven. Results of this study indicate that about 65% of the respondents had used the microwave oven for 10 to 19 years and about 65% of the respondents were less than 75 years old. It appears from these results that the cohort of these older adults were probably in the age group of 45 to 55 years, 20-25 years ago when the saturation of microwave ovens was increasing rapidly. Previous research indicates that younger consumers adopted the microwave oven more than older consumers (Wilson, 1969; Freeman, 1982) and older adults were the last to adopt new products (Gilly & Zeithaml, 1985). It would be justified then to propose that twenty years ago these current older adults were “younger,” at their peak earning power, and home renovation age, and therefore had adopted the microwave oven during their younger years. It appears that adoption will only get higher with the subsequent older age cohorts as they are more accustomed to using the microwave oven.

Judging from the subjective responses obtained in this study and its high saturation level (90%), it is quite possible that microwave ovens has become as essential as a range or refrigerator in a person’s home. It would be interesting to observe comparison in saturation levels between the range and the microwave oven 20 years into the future. One should remember that this is a dynamic and ever changing process.

The older adults of this study belonged to the cohort of the Depression and this could be the reason for their resistance to adopt microwaveable food products. The foods industry should assess the situation and devise strategies to target this group and their needs and preferences. This is a large market segment that could greatly enhance sales with good marketing. Preference for certain features, controls, size, wattage, and other advantages by older adults should be considered by the industry in

future designs. User-based product evaluations with specific target groups could be an effective way to reach these conclusions.

Retirement communities need to give considerable thought to incorporating microwave ovens in their independent living and assisted living facilities. Older adults may be encouraged to prepare a snack or meal if they associate little physical difficulty with the activity. This will reinforce the residents' sense of control and give them a sense of independence.

Limitations

Due to time and financial constraints, the study was limited to determining extent of adoption of microwave ovens among a single community of older adults in Blacksburg, Virginia. Specific limitations of the study are:

1) Only 75 older adults were interviewed for the study.
2) Telephone interviews were conducted instead of personal interviews due to time constraints.
3) Only a limited number of questions was asked of the respondents during these interviews. This was because it was assumed that older adults get tired easily with lengthy interviews. Therefore, specific foods that were cooked, heated, or prepared in the microwave oven were not determined.
4) Owing to the fact that the sample was selected from a directory of retired university personnel, there was little variance in educational background. It is therefore difficult to extend the generalizability of this study to the entire population of older adults. However, it appears that education could be a significant predictor of microwave oven adoption. This can be strengthened through empirical research targeting a larger population of older adults with more variance in educational background.

Recommendations for Further Study

The model used in this study involved two predictor variables, frequency of use in comparison to the range, and complexity of food preparation to determine level of adoption. For future replication, the researcher recommends the incorporation of other predictors such as: frequency in terms of number of times used and years of

experience. Also, it might be interesting to seek answers to the question: Could you do without a microwave oven for cooking purposes? Most of the subjective responses received during the course of the telephone interviews were: “Can’t do without it,” “would be lost without it,” “is as essential as a refrigerator, or range,” and “indispensible in my kitchen.” Further subdivisions of the level of adoption variable (i.e. high, medium-high, medium, medium-low, and low) may be carried out to get a finer description. More information should be acquired on meal patterns; e.g., what is eaten at every meal, how many meals are prepared, does preparation require the use of appliances, or are older adults eating out more than cooking at home. Unless a detailed assessment of meal patterns is carried out, it is difficult to predict the usage of one appliance over the other.

Level of adoption of microwave ovens among older adults should be studied keeping the qualitative factor in mind. In-depth interviews would be a better method to follow in order to get additional and more precise information regarding microwave oven use. Also, a greater number of interviews should be conducted to increase reliability. Surely persons who feel so strongly about their microwave oven are high adopters even if they do not use it for high-complexity chores.

Certain specific recommendations for further research in the field have been identified.

1) Replication of the study in different geographic locations will help to determine levels of adoption among older adults nationally and trends can be established.
2) Personal interviews should be conducted instead of telephone interviews to get more accurate data.
3) A user-based evaluation and task-analysis approach would be effective in obtaining objective and practical information. Also, this will give insight to design modifications of the microwave ovens that are desired by older adults.
4) More open-ended questions should be asked to get clearer descriptive information.
5) The model of level of adoption can be revised to incorporate other variables. Specifically, frequency of use in comparison to the range should be broadened to include actual frequency of use and comparison with range oven, wall oven, and

surface burners or elements.

6) Level of adoption could be subdivided into more than three categories to get a clearer picture.
7) Further analysis of the data collected from this study could reveal other significant relationships and interactions.

Implications

The results of this study have the following implications for appliance manufacturers, researchers in household equipment, and management of retirement communities.

For Appliance Manufacturers

The high levels of adoption of the microwave oven reflect that the elderly are a significant group to target for increased microwave oven sales. This is also observed in the percentage of older adults who are willing to purchase another microwave oven. Preferences of older adults to types of controls and features will be useful to appliance marketers in identifying certain models that will better satisfy the elderly consumer. This study reported that the majority of the respondents had touch controls on their microwave oven. However, at the same time, it was observed that high adopters preferred using rotary dials or slider controls to touch controls. A more detailed study on selection of controls by the elderly population is needed. Appliance manufacturers should consider conducting national surveys among older adults to determine type of controls, size and wattage, and features desired by the over 65 age group. Also, door swings need to be assessed. Currently, all microwave oven doors swing open to the left. Microwave ovens with door swings to the right would increase flexibility in placement in kitchens.

For Researchers in Household Equipment

There are immense possibilities to test the adoption of different household appliances among older adults. Rogers' theory of adoption can be used to determine the extent of adoption of new innovative technological appliances in the market. It would be interesting to study the differences in the rate of adoption of a new appliance among different age groups. Product evaluations could be conducted to determine

usability of the controls of microwave ovens. Standards need to be established on the correct height for placement of microwave ovens. Flexibility in design like door-swings to the right or bottom hinged doors could be studied and evaluated.

For Retirement Communities

Since the results clearly indicate that older adults want to use microwave ovens even if they move to a different place of residence like a retirement community, the management of these facilities should consider providing microwave ovens for use by residents, or provide a space where one can be placed in the kitchen area. A built-in cabinet would be a good choice as it could provide extra storage and free up more counter space. If allowing placement of the microwave oven on the countertop is to occur, it should be recognized that more counter space should be provided for other food preparation tasks. Providing a microwave/convection oven could help to eliminate the use of the traditional oven.

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Appendix A

Instrument

ADOPTION OF MICROWAVE OVENS

1. Do you know the brand name of the microwave oven you have?

2 = Yes **1= No**

Name: _____

2. Do you have more than one microwave oven in your home?

2 = Yes **1= No**

If the response is YES, please answer the following questions with reference to the more frequently used microwave oven.

3. How did you get it?

1 – **self-purchased**

2 - **gift**

3 - **prize**

4 - **borrowed**

5 - **other _____**

4. How many microwaves have you owned before this one?

1 - **none**

2 - **one**

3 - **two**

4 **– other _____**

5. How long have you had this microwave oven?

1 - **less than a year**
2 - **>1 year - 3 years**
3 - **> 3 years - 5 years**
4 - **> 5 years - 7 years**
5 - **> 7 years – 10 years**
6 **– more than 10 years**

6. When did you first start using a microwave oven?

_____

7. What prompted you to start using it?

_____

8. Where is your microwave oven located in your residence?

1 - **kitchen**

2 - **dining area**

3 - **other _____**

9. Is your microwave oven located:

1 – **on the countertop**

2 – **under the wall cabinet**

3 – **over the range**

4 **– on a cart**

5 **– in a separate cabinet**

6 **– other _____**

10. Is the microwave oven located such that, the control panel is:

1 **– at your eye-level**

2 **– below your eye-level**

3 **– above your eye-level**

11. Does your microwave have:

1 – **touch control panel**

2 – **rotary dials**

3 – **combination of both**

12. What features does your microwave oven have?

1 – **programmed controls**

defrost ☐
reheat ☐
popcorn ☐
vegetables ☐
meat ☐
tea ☐
coffee ☐

2 - **adjustable power levels** ☐

_____

3 - **adjustable temperature levels** ☐

_____

4 – **clock** ☐

5 – **timer** ☐

6 – **convection** ☐

7 - **browning element** ☐

8 - **other _____**

13. Do you plan to buy a microwave oven in the future?

2 = Yes **1= No**

Why? _____

_____

14. If you were to buy another microwave oven, what other features would you like it to have?

_____

_____

_____

15. With regards to using your microwave oven, do you think you:

1 = **know the operation of all features**

2 – **know the operation of the features required for the items you prepare**

3 – **know limited operation of features**

COMPLEXITY OF PREPARATION

16. Do you use the microwave oven for:.

☐ 1 – **heating small quantities of water,**

☐ 2 **– reheating leftovers**

☐ 3 – **partial preparation (like melting butter, chocolate, defrost)**

☐ 4 – **preparing convenience foods (like microwaveable lasagne, chicken, TV dinners)**

☐ 5 – **Complete preparation from scratch**

17. What do you use the microwave oven most often for:.

☐ 1 – **heating small quantities of water,**

☐ 2 **– reheating leftovers**

☐ 3 – **partial preparation (like melting butter, chocolate, defrost)**

☐ 4 – **preparing convenience foods (like microwaveable lasagne, chicken, TV dinners)**

☐ 5 – **Complete preparation from scratch**

FREQUENCY (Descriptive statistics)

18. On an average, how often do you use the microwave oven? _____

1 - **2-3 times a day**
2 - **once a day**
3 - **once in 2 days**
4 - **2-3 times a week**
5 - **once a week**
6 - **once in 2 weeks**
7 - **once a month**
8 – **never**

19. On an average, how many items do you prepare daily for:

1 – **Breakfast _____**
2 – **Lunch _____**
3 – **Dinner _____**
4- **Snacks _____**

FREQUENCY (Level of adoption)

20. Do you use the microwave oven :

1 - **never**

2 - **less than your range**

3 - **about the same**

4 - **more than your range**

21. Do you think you use the microwave oven MORE often now than when you first got it?

2 = Yes **1= No**

Why? _____

_____

SATISFACTION

22. Are you satisfied with the time it takes to cook in the microwave?

2 = **Yes**

1 = **Somewhat**

0 = **No**

23. Are you satisfied with the convenience of cooking in the microwave oven?

2 = **Yes**

1 = **Somewhat**

0 = **No**

24. Are you satisfied with the quality of the foods with microwave cooking?

2 = **Yes**

1 = **Somewhat**

0 = **No**

25. If you were to move to a different place to live, would you want to have a microwave oven available for your use?

2 = **Yes** 1 = **No**

Why?_____

_____

Now, I'll ask you some questions about yourself!!

26. Do you wear glassess?

2 = **Yes** 1 = **No**

If Yes, Do you wear:

1 - **Bifocals**

2 – **Trifocals**

3 **– Other** _____

27. Is it difficult for you to read the information on the control panel of your microwave ?

2 = **Yes** 1 = **No**

Describe:_____

28. Is it difficult for you to hear the timer on your microwave oven?

2 = **Yes** 1 = **No**

Describe: _____

_____

29. Is it difficult for you to operate the controls on your microwave oven?

2 = **Yes** 1 = **No**

Describe: _____

_____

I will now ask you for some background information about yourself!!

30. How many members are there in your household?

_____

31. What is your marital status?

1- never married

2- previously married

3- currently married

32. What is the highest educational level you've attained? _____

33. What was your occupation before you retired?

_____

Thank you for your participation in this survey!!

Appendix B

Letter sent to respondents

March 3, 1998

Dear

You have been selected to participate in a telephone interview to answer questions regarding the level of adoption of the microwave oven by older adults residing in Blacksburg, Virginia.

You will receive a telephone call between March 16th and 26th , any time from 10:30 am –12:30 pm or 6:00 pm - 8:00 pm. The interview will take 10-15 minutes. You do not have to reschedule other appointments for this interview. You will be interviewed only if you:

1. Were born in or before 1933,
2. have a microwave oven in your house, and
3. are the **primary user** of the microwave oven

If for any reason, you do not wish to participate in this study, do not wish to be disturbed by the telephone call, or do not meet any of the above criteria, feel free to call me at 961-2089 or email me at annagara@vt.edu and leave a message. I look forward to speaking with you soon.

Sincerely,

Anandi Nagarajan
M.S. Candidate

Thank you for assisting Anandi Nagarajan by participating in her study. The information she gathers will be useful to assess levels of adoption of the microwave oven by older adults.

Rebecca P. Lovingood, Ph.D.
Department Head

Appendix C
Application to Institutional Review Board at Virginia Tech

Adoption of Microwave ovens by Older Adults in Blacksburg, Virginia

PROTOCOL

Justification:

The consumer market comprises a large proportion of elderly adults today. Harris (1988) reported that older Americans want, need, and are willing to pay for products that give them convenience and independence. The microwave oven, with its advantages of cooking speed, convenience in use, availability range, affordable cost, and versatile performance would be an ideal appliance for the older consumer. However, one should understand that ownership of the microwave oven does not necessarily imply use.

Though previous research has alluded to the fact that microwave ovens are not as popular with the elderly as with younger users due to a variety of reasons, Neimeyer et al. (1997) suggested that older females find the use of the microwave oven to be one of the five easiest functional tasks in the home. Also, the specific reason(s) for low percentages of microwave use by older adults have not been identified. The researcher believes that this could be due to low adoption of new technology or due to design technicalities that make the microwave oven a complex appliance to use by older adults.

In an effort to better structure this research, the researcher conducted a pilot study with older adults to assess the ownership of appliances, frequency of use, and problems associated with the design of appliances. Five retired female faculty of Virginia Polytechnic Institute & State University, over the age of 65 residing in Blacksburg, Virginia, were interviewed for this purpose. Contrary to previous readings in the field, the researcher found that four of the five women used microwave ovens intensively and did not perceive any design problems with the ones they owned. However, one participant did not possess a microwave oven out of personal choice and felt that it was an unsafe appliance to use. Due to the contradiction in the findings of this pilot study and previous research, the researcher considers this to be an area worth investigating.

Procedures:

The participants for the study will be selected from a random sample of 128 drawn from the Directory of Retired Personnel 1997-98, Virginia Tech. The criteria for selection include:

- Should be 65 years of age or older
- Have a microwave oven in their current residence
- Should be the primary user of the microwave oven

Letters will be sent to 128 selected participants informing them of the study and asking them to expect a telephone call. Telephone interviews will be conducted with the participants between March 16th and 26th, from 10:30 am – 12:30 pm or 6:00 pm – 8:00pm. The interviews are expected to last 10-15 minutes. Data from the first 75 completed interviews will be used for this study.

Risks and Benefits:

The participants will be under no risk if they participate in this interview. However, there are no monetary benefits attached to participation. Interviews will be conducted based on consent of the participant.

Confidentiality:

The interviews will be coded with identification numbers, merely for the purpose of cross-references in case of necessary clarification. Access to the data will be limited to the investigator and her advising committee.

Biographical Sketch:

Principal Investigator

Anandi Nagarajan is a Master's student with the Department of Housing, Interior Design, and Resource Management, now called Near Environments. She is also a candidate for the Certificate program in Gerontology. She holds an undergraduate degree in interior design from SNDT university, Bombay, India.

She has been a graduate assistant at the Department of HIDM for the entire period of her masters degree. Projects completed by her include:

- Appliance redesign for elderly users – term paper for Adult Development and Aging I, Fall 1997

- Satisfaction of kitchen design by elderly users – research and data analysis with Dr. Julia Beamish, HIDM, Fall 1997
- Refrigerator design implications for egg storage – Third author to the paper presented at International Appliance Technical Conference, Columbus, Ohio, May 1997
- User-friendliness of control panels on household appliances – class project in Orientation to research, Fall 1996

See Curriculum Vitae for further details.

Major Advisor

Dr. Rebecca Lovingood, Ph.D., CFCS, holds the rank of professor in the Department of Near Environments (formerly the Department of Housing, Interior Design, and Resource Management/Clothing and Textiles). She has been a faculty member at Virginia tech since September 1973. With responsibility for resident instruction and research in residential appliances and other related areas. She holds the B.S., M.S., and Ph.D. degrees from The Ohio State University, and has receives several international and national recognition for survey research on a number of topics, including a study of microwave usage patterns among college students at Virginia Tech, homeowner perception and response to radon, and consumer laundry practices and satisfaction before and after the ban on laundry detergents that contain phosphates. She has also directed a number of laboratory-based projects focussed on user-interaction with appliances and the effect of user behavior on appliance energy consumption.

Appendix D

Cross tabulation between

Marital Status and Number of Members in the Household

Cross tabulation between Marital status and Number of Members in Household

Marital Status		**Number of members (N)**				
		1	**2**	**3**	**4**	**Total**
Never married	**1**	4	1	0	0	5
Previously married	**2**	15	1	0	0	16
Currently married	**3**	0	48	5	1	54
Total		19	50	5	1	75

Marital Status		**Number of members (%)**				
		1	**2**	**3**	**4**	**Total**
Never married	**1**	5.3	1.35	0	0	6.7
Previously married	**2**	20.0	1.35	0	0	21.3
Currently married	**3**	0	64.0	6.7	1.3	72.0
Total		25.3	66.7	6.7	1.3	100.0

Appendix E

Cross tabulation between

Gender and Number of Members in Household

Cross tabulation between Gender and Number of Members in Household

Gender		**Number of members (N)**				
		1	**2**	**3**	**4**	**Total**
Males	**1**	6	26	1	0	33
Females	**2**	13	24	4	1	42
Total		19	50	5	1	75

CURRICULUM VITAE

Anandi Nagarajan was born in Vishakapatnam, India on April 15, 1974. She received her Bachelors degree in Family Resource Management with a specialization in Residential Space Planning and Management, from Shreemati Nathibai Damodar Thackersey Women's University, Bombay, India in 1995.

After studying the graduate program at the same university for another year, Anandi enrolled as a full-time graduate student in the Department of Housing, Interior Design, & Resource Management at Virginia Polytechnic Institute and State University in 1996. She held the position of graduate assistant for the two years of her graduate study and assisted in several research and departmental projects. She also assisted in teaching some classes and laboratories.

Anandi was the recipient of the 1997 Virginia Association of Family and Consumer Sciences Award and a scholarship from the Electrical Women's Round Table, Inc. Anandi received her Masters degree in Housing, Interior Design, & Resource Management in 1998.

Her future plans involve pursuit of doctoral studies in education. Her long-term occupational objective is to re-enter the field of academia as an educator.